

# Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as Spectrum Analyzers, Signal Generators, Oscilloscopes, Power Meters, Network Analyzers etc from all the major suppliers such as Keysight, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. We fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 1 year warranty. Our staff have extensive backgrounds in T&M which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, presenting flexible technical + commercial solutions and supplying a loan unit during warranty repair, if available.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based in at Oakley, Bedfordshire in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our 40GHz in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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# Arbitrary Waveform Generators

## AWG5200 Series Datasheet



The AWG5200 Series arbitrary waveform generator (AWG) leads the way in signal generation by enabling bleeding-edge innovation for engineers and researchers. The AWG5200 Series of AWGs delivers unparalleled signal fidelity coupled with class-leading sample rate and memory depth, giving you the industry's best signal stimulus solution for complex RF baseband signal generation and precision experimental applications. With up to 5 GS/s sample rate (10 GS/s with interpolation) and 16-bit vertical resolution, the AWG5200 Series offers easy generation of complex signals as well as accurate playback of existing captured signals.

### Key performance specifications

- Sample rates up to 10 GS/s (with 2x interpolation)
- 2, 4, and 8 channel configurations
- -70 dBc spurious free dynamic range
- 16 bits vertical resolution
- 2 GSamples waveform memory per channel

### Key features

- Complete solution for complex RF signal generation in a single box
  - Direct generation of signals with carriers up to 4 GHz, removing the need for external RF conversion
- Simulate real-world analog effects on high speed digital data streams
- Generate high precision RF signals
  - Spurious Free Dynamic Range performance better than -70 dBc
- Create long complex waveforms without compromising bandwidth
  - Up to 2 GSamples of Waveform Memory plays 400 ms of data at 5 GS/s and 800 ms of data at 2.5 GS/s
- Synchronize multiple units to achieve a multi-channel high speed AWG system
- Fully operational without external PC
  - Built-in display and buttons make it possible to quickly select, edit, play waveforms and trigger on events directly from the AWG front panel

- Simulate real-world environments by playing back captured signals
  - Waveforms captured with Oscilloscopes or Real-Time Spectrum Analyzers can be played back, edited or re-sampled on the AWG
- Smooth transition from simulation to the real-world testing environment
  - Waveform vectors imported from third-party tools such as MATLAB

### Applications

- RF/MW waveform generation for communications and defense electronics testing and development
  - Output RF signals directly up to 4 GHz
- Leading edge research in electronics, physics & chemistry
  - High speed, low jitter signal source generates uniquely specified analog signals, fast pulses, data streams and clocks

### Seamless transition from simulation to generation

If a waveform can be defined or captured, then the AWG5200 can reproduce this signal. The creation of the waveform can happen in many ways. An extensive and growing library of waveform generation plugins which are optimized to work specifically with the Tektronix AWG family, provide specific waveform creation capabilities, while 3rd party solutions like MATLAB, Excel, or others, have the flexibility to create and import any waveform you desire. Waveforms created in any of these packages can be imported and played back in the AWG5200, seamlessly transitioning from the simulation world to the real world.

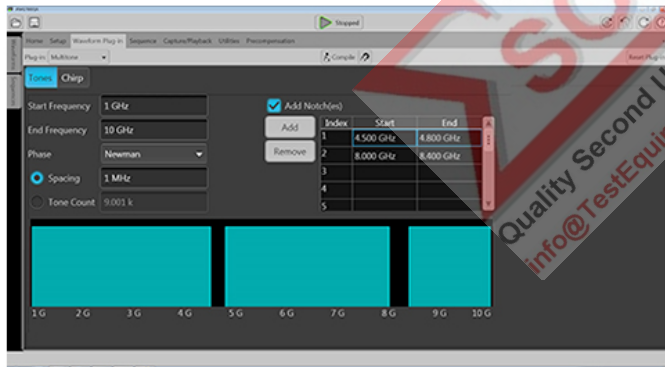
### Advanced remote instrument control and waveform generation

The new SourceXpress platform brings all of your AWG instrument control and waveform generation capabilities to your Microsoft® Windows PC. Load waveforms, create sequences, and enable playback without ever having to touch an AWG. All waveform creation plug-ins run natively on the SourceXpress platform, allowing you to quickly iterate through test signals without having to set foot in the lab.



## RF signal generation

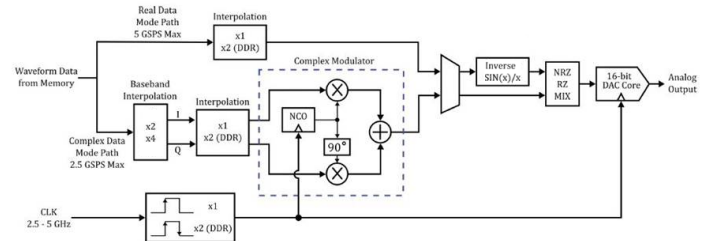
RF signals are becoming more and more complex, making it difficult for RF engineers to accurately create the signals required for conformance and margin testing. When combined with the RF Generic waveform creation plug-in, the AWG5200 Series can address these tough design challenges. The RF Generic plug-in is a software package that digitally synthesizes modulated baseband, IF, and RF signals taking signal generation to new levels by fully exploiting the advanced signal generation capabilities of the AWG5200 Series arbitrary waveform generators.



## Built in digital IQ modulator

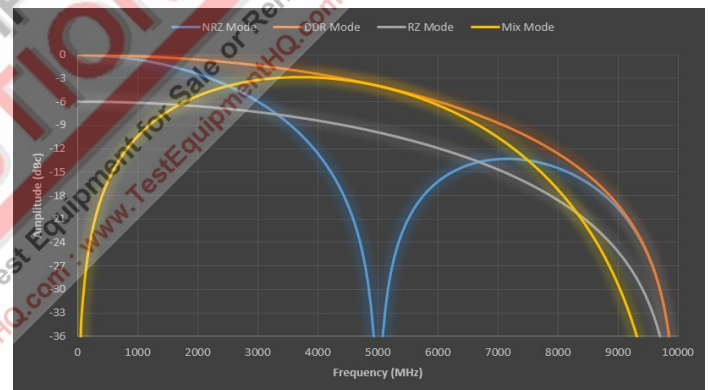
Reducing the size and cost for telecommunication and military systems is driving the evolution of modern DAC's to integrate more functionality into a single chip. Some of the more advanced high-speed DAC's also incorporate digital signal processing and conditioning functionalities such as digital interpolation, complex modulation, and numerically controlled oscillators (NCO). This enables direct generation of complex RF signals in an efficient and compact way.

The Tektronix AWG5200 series features a digital complex modulator and multi-rate interpolation. With this internal IQ modulation feature, you remove the IQ mismatches that are attributed to external modulators and mixers. Also with this modulator, there is no in-band carrier feed-through, and there are no images. With its built in interpolators, it also affords the ability to create waveforms most efficiently reducing waveform size and compilation times as well as extending playback time.



## Several DAC modes available

With the AWG5200 DAC there are several modes that enable you to output your signal at the cleanest portion of the DAC BW and frequency roll off positions.



## Environment signal generation

The mission-critical nature of many radar signals requires that they coexist with standards-based commercial signals sharing the same spectrum without performance degradation. To meet this expectation, a radar designer has to thoroughly test all the corner cases at the design/debug stage. The AWG5200 offers the extreme flexibility and precision needed to play back these worst-case scenarios.

## Specifications

All specifications are typical unless noted otherwise. All specifications apply to all models unless noted otherwise.

### Hardware characteristics

|                                     |   |
|-------------------------------------|---|
| <b>Number of analog outputs</b>     |   |
| AWG5202                             | 2   |
| AWG5204                             | 4   |
| AWG5208                             | 8   |
| <b>Analog output connector type</b> | SMA female  |
| <b>Analog output impedance</b>      | 50 $\Omega$   |
| <b>Number of marker outputs</b>     |   |
| AWG5202                             | 8   |
| AWG5204                             | 16  |
| AWG5208                             | 32  |
| <b>Resolution (nominal)</b>         | 16 bits with no markers active, 15 bits with 1 marker active, 14 bits with 2 markers active, 13 bits with 3 markers active, 12 bits with 4 markers active |
| <b>Waveform memory</b>              | 2 GS/channel  |
| <b>Waveform granularity</b>         | 1 sample  |
| <b>Waveform minimum size</b>        | 2400 samples  |
| <b>Run modes</b>                    |   |
| Continuous                          | Waveform is continuously repeated   |
| Triggered                           | Waveform is output only once after a trigger is received  |
| Triggered Continuous                | Waveform is continuously repeated after a trigger is received   |
| Gated                               | Waveform is continuously repeated while the trigger is enabled  |
| <b>Sample rate (nominal)</b>        | 300 S/s to 5 GS/s (10 GS/s Interpolated - Double Data Rate)   |
| <b>Sin(x)/x (-3dB)</b>              | 2.22 GHz @ 5 GS/s, 4.44 GHz Interpolated @ 10 GS/s  |

### Computer characteristics

|  |   |
|--|---|
| <b>Operating system / peripherals / IO</b> | Microsoft® Windows OS   |
|  | USB 2.0 compliant ports (2 front)   |
|  | USB 3.0 compliant ports (4 rear)  |
|  | RJ-45 Ethernet connector (rear panel) supports 10/100/1000BASE-T            |
|  | VGA video (rear panel) for external monitor                                 |
| <b>Display characteristics</b>             | eSATA (rear panel)  |
|  | LED backlit touch screen display, 165 mm (6.5 in.) diagonal, 1024 × 768 XGA |
|  | Software driver for third-party applications                                |
|  | IVI-COM driver  |
|  | IVI-C driver  |



## Analog output characteristics

|  |   |
|--|---|
| <b>Effective frequency output</b>                  | Fmaximum (specified) is determined as "sample rate / oversampling rate" or "SR / 2.5".<br>2 GHz<br>4 GHz (Double Data Rate - DDR mode)  |
| <b>DC High Bandwidth output</b>                    | Amplitude levels are measured as singled-ended outputs. Output doubles when using differential (both) outputs.  |
| <b>Amplitude range</b>                             | 25 mV <sub>p-p</sub> to 0.75 V <sub>p-p</sub> (single ended, 50 Ω terminated)<br>50 mV <sub>p-p</sub> to 1.5 V <sub>p-p</sub> (differential mode, 100 Ω terminated)   |
| <b>Amplitude accuracy (guaranteed)</b>             | ±2% of setting ≥ 100 mV <sub>p-p</sub><br>±5% of setting < 100 mV <sub>p-p</sub>  |
| <b>Offset</b>                                      | ±2 V (50 Ω into gnd), ±4 V into DC voltage terminated   |
| <b>Offset accuracy</b>                             | ±(2% of  offset  + 10 mV); into 50 Ω to Gnd. (Common mode, guaranteed.)<br>±25 mV; into 100 Ω differential. (Differential mode.)  |
| <b>Analog bandwidth</b>                            | At 750 mV <sub>p-p</sub> : DC to 2 GHz (3 dB), DC to 4 GHz (6 dB)   |
| <b>Rise/fall time</b>                              | Rise/fall time measured at 20% to 80% levels.<br>< 110 ps at 1.5 V <sub>p-p</sub> single-ended termination  |
| <b>DC High Bandwidth Amplified output (option)</b> | Amplitude levels are measured as singled-ended outputs. Output doubles when using differential (both) outputs.  |
| <b>Amplitude range</b>                             | 25 mV <sub>p-p</sub> to 1.5 V <sub>p-p</sub> (single ended, 50 Ω terminated)<br>50 mV <sub>p-p</sub> to 3.0 V <sub>p-p</sub> (differential mode, 100 Ω terminated)  |
| <b>Amplitude accuracy (guaranteed)</b>             | ±2% of setting ≥ 100 mV <sub>p-p</sub><br>±5% of setting < 100 mV <sub>p-p</sub>  |
| <b>Offset</b>                                      | ±2 V (50 Ω into gnd), ±4 V into DC voltage terminated   |
| <b>Offset accuracy</b>                             | ±(2% of  offset  + 10 mV); into 50 Ω to Gnd. (Common mode, guaranteed.)<br>±25 mV; into 100 Ω differential. (Differential mode.)  |
| <b>Analog bandwidth</b>                            | At 750 mV <sub>p-p</sub> : DC to 2 GHz (3 dB), DC to 4 GHz (6 dB)<br>At 1.5 V <sub>p-p</sub> : DC to 1.3 GHz (3 dB)   |
| <b>Rise/fall time</b>                              | Rise/fall time measured at 20% to 80% levels.<br>< 180 ps at 1.5 V <sub>p-p</sub> single-ended  |
| <b>DC High Voltage output</b>                      | Amplitude levels are measured as singled-ended outputs. Output doubles when using differential (both) outputs.  |
| <b>Amplitude range</b>                             | 10 mV <sub>p-p</sub> to 5.0 V <sub>p-p</sub> (single ended, 50 Ω terminated)<br>20 mV <sub>p-p</sub> to 10.0 V <sub>p-p</sub> (differential mode, 100 Ω terminated)   |
| <b>Amplitude accuracy (guaranteed)</b>             | ±2% of amplitude ≥ 160 mV <sub>p-p</sub><br>±5% of amplitude < 160 mV <sub>p-p</sub>  |
| <b>Offset</b>                                      | ±2 V (50 Ω into gnd), ±4 V into high resistance or matching voltage terminated  |
| <b>Offset accuracy</b>                             | ±(2% of  offset  + 1% of amplitude + 20 mV). (50 Ω-to-Gnd) (Common mode guaranteed.)<br>± 88 mV; into 100 Ω. (Differential mode.)   |
| <b>Analog bandwidth</b>                            | DC – 370 MHz (3 dB) (at 2 V <sub>p-p</sub> ) DC – 200 MHz (3 dB) (at 4 V <sub>p-p</sub> )   |
| <b>Rise/fall time</b>                              | Rise/fall time measured at 20% to 80% levels.<br>< 1.3 ns, at 5 V <sub>p-p</sub> single-ended.<br>< 1.1 ns, at 4 V <sub>p-p</sub> single-ended.<br>< 0.8 ns, at 3 V <sub>p-p</sub> single-ended.<br>< 0.6 ns, at 2 V <sub>p-p</sub> single-ended. |

**Analog output characteristics**

|                               |   |
|-------------------------------|---|
| <b>AC Direct output</b>       | Amplitude levels are measured as singled-ended outputs.         |
| Amplitude range               | -17 dBm to -5 dBm   |
| Amplitude accuracy            | ±0.5 dBm at 100 MHz   |
| DC bias                       | ±5 V at 150 mA  |
| DC bias accuracy (guaranteed) | ±(2% of bias + 20 mV); into an open circuit (zero load current) |
| Analog bandwidth              | 10 MHz - 2 GHz (-3 dB), 10 MHz - 4 GHz (-6 dB)                  |

|                                     |  |
|-------------------------------------|--|
| <b>AC Amplified output (option)</b> | Amplitude levels are measured as singled-ended outputs.                          |
| Amplitude range                     | -85 dBm to +10 dBm (10 MHz to 3.5 GHz)<br>-50 dBm to +10 dBm (>3.5 GHz to 5 GHz) |
| Amplitude accuracy                  | ±0.5 dBm at 100 MHz  |
| DC bias                             | ±5 V at 150 mA   |
| DC bias accuracy (guaranteed)       | ±(2% of bias + 20 mV); into an open circuit (zero load current)                  |
| Analog bandwidth                    | 10 MHz - 2 GHz (-3 dB), 10 MHz - 4 GHz (-6 dB)                                   |

**Output match VSWR**

| Output path   | Specification   |
|---|---|
| DC High Bandwidth (including DCHB Amplified option) | DC to 1 GHz < 1.25:1<br>1 GHz to 3 GHz < 1.9:1<br>3 GHz to 4 GHz < 2.3:1                                      |
| DC High Voltage                                     | DC to 400 MHz < 1.6:1<br>400 MHz to 1 GHz < 1.75:1<br>1 GHz to 2 GHz < 2.3:1                                  |
| AC Direct   | 10 MHz to 300 MHz < 2.0:1<br>300 MHz to 1.4 GHz < 1.6:1<br>1.4 GHz to 3 GHz < 2.2:1<br>3 GHz to 4 GHz < 2.5:1 |
| AC Amplified, +3 dBm                                | 10 MHz to 500 MHz < 2.4:1<br>500 MHz to 1.5 GHz < 1.75:1<br>1.5 GHz to 4 GHz < 1.9:1                          |

|                 |  |
|-----------------|--|
| <b>Bit rate</b> | Bit rate determined as "sample rate / 4 points per cycle", allowing full impairment generation.<br>1.25 Gb/s at 5 GS/s |
|-----------------|--|

**Channel timing characteristics**

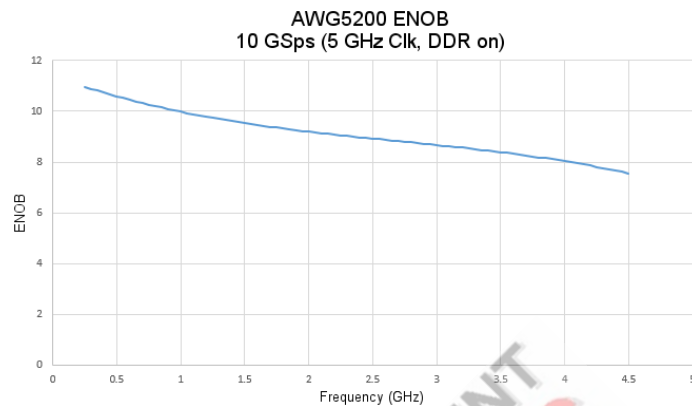
|  |        |
|--|--------|
| <b>Channel to channel skew (DC high bandwidth mode only)</b> | ±25 ps |
| <b>Skew adjust</b>   |        |
| Range  | ±2 ns  |
| Resolution   | 250 fs |

## Sequencer characteristics

|                          |                       |
|--------------------------|-----------------------|
| Maximum sequencing steps | 16,384                |
| Sub sequencing           | Single level of depth |

## Spurious Free Dynamic Range (SFDR) characteristics

Effective number of bits (ENOB)



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## Spurious Free Dynamic Range (SFDR) characteristics

### SFDR characteristics

SFDR is determined as a function of the directly generated carrier frequency.

Harmonics not included. Measured with a balun and with output amplitude set to 500 mV.

### DC High Bandwidth

500 mV<sub>pp</sub>

| 2.5 GS/s |                                 | In band performance |               | Adjacent band performance |               |
|----------|---------------------------------|---------------------|---------------|---------------------------|---------------|
|          | Analog channel output frequency | Measured across     | Specification | Measured across           | Specification |
|          | 100 MHz                         | 10 to <1250 MHz     | -80 dBc       | –                         | –             |
|          | 10 to <155 MHz                  | 10 to <1250 MHz     | -80 dBc       | –                         | –             |
|          | 155 to <1000 MHz                | 10 to <1000 MHz     | -53 dBc       | 1000 to <1250 MHz         | -60 dBc       |
|          | 1000 to <1250 MHz               | 1000 to <1250 MHz   | -50 dBc       | 10 to <1000 MHz           | -50 dBc       |
| 5 GS/s   |                                 | In band performance |               | Adjacent band performance |               |
|          | Analog channel output frequency | Measured across     | Specification | Measured across           | Specification |
|          | 100 MHz                         | 10 to <1250 MHz     | -80 dBc       | 1250 to <2500 MHz         | -75 dBc       |
|          | 10 to <310 MHz                  | 10 to <1250 MHz     | -80 dBc       | 1250 to <2500 MHz         | -70 dBc       |
|          | 310 to <1250 MHz                | 10 to <1250 MHz     | -67 dBc       | 1250 to <2500 MHz         | -64 dBc       |
|          | 1250 to <2000 MHz               | 1250 to <2000 MHz   | -53 dBc       | 10 to <1250 MHz           | -38 dBc       |
|          |                                 | –                   | –             | 2000 to <2500 MHz         | -58 dBc       |
|          | 2000 to <2500 MHz               | 2000 to <2500 MHz   | -33 dBc       | 10 to <2000 MHz           | -31 dBc       |
| 10 GS/s  |                                 | In band performance |               | Adjacent band performance |               |
|          | Analog channel output frequency | Measured across     | Specification | Measured across           | Specification |
|          | 100 MHz                         | 10 to <1250 MHz     | -80 dBc       | 1250 to <5000 MHz         | -69 dBc       |
|          | 10 to <625 MHz                  | 10 to <1250 MHz     | -74 dBc       | 1250 to <5000 MHz         | -63 dBc       |
|          | 625 to <1250 MHz                | 10 to <1250 MHz     | -69 dBc       | 1250 to <5000 MHz         | -59 dBc       |
|          | 1250 to <2000 MHz               | 1250 to <2000 MHz   | -63 dBc       | 10 to <1250 MHz           | -60 dBc       |
|          | –                               | –                   | –             | 2000 to <5000 MHz         | -54 dBc       |
|          | 2000 to <3500 MHz               | 2000 to <3500 MHz   | -50 dBc       | 10 to <2000 MHz           | -47 dBc       |
|          | –                               | –                   | –             | 3500 to <5000 MHz         | -50 dBc       |
|          | 3500 to <4000 MHz               | 3500 to <4000 MHz   | -53 dBc       | 10 to <3500 MHz           | -43 dBc       |
|          | –                               | –                   | –             | 4000 to <5000 MHz         | -54 dBc       |

### AC Direct Out

-5.0 dBm. Harmonics not included. Measured at the maximum output amplitude.

| 2.5 GS/s |                                 | In band performance |               | Adjacent band performance |               |
|----------|---------------------------------|---------------------|---------------|---------------------------|---------------|
|          | Analog channel output frequency | Measured across     | Specification | Measured across           | Specification |
|          | 100 MHz                         | 10 to <1250 MHz     | -80 dBc       | –                         | –             |
|          | 10 to <155 MHz                  | 10 to <1250 MHz     | -80 dBc       | –                         | –             |
|          | 155 to <1000 MHz                | 10 to <1000 MHz     | -62 dBc       | 1000 to <1250 MHz         | -66 dBc       |
|          | 1000 to <1250 MHz               | 1000 to <1250 MHz   | -60 dBc       | 10 to <1000 MHz           | -62 dBc       |



## Spurious Free Dynamic Range (SFDR) characteristics

| 5 GS/s |                                 | In band performance |               | Adjacent band performance |               |
|--------|---------------------------------|---------------------|---------------|---------------------------|---------------|
|        | Analog channel output frequency | Measured across     | Specification | Measured across           | Specification |
|        | 100 MHz                         | 10 to <1250 MHz     | –80 dBc       | 1250 to <2500 MHz         | –75 dBc       |
|        | 10 to <310 MHz                  | 10 to <1250 MHz     | –80 dBc       | 1250 to <2500 MHz         | –70 dBc       |
|        | 310 to <1250 MHz                | 10 to <1250 MHz     | –67 dBc       | 1250 to <2500 MHz         | –60 dBc       |
|        | 1250 to <2000 MHz               | 1250 to <2000 MHz   | –58 dBc       | 10 to <1250 MHz           | –55 dBc       |
|        |                                 | –                   | –             | 2000 to <2500 MHz         | –60 dBc       |
|        | 2000 to <2500 MHz               | 2000 to <2500 MHz   | –62 dBc       | 10 to <2000 MHz           | –51 dBc       |

| 10 GS/s |                                 | In band performance |               | Adjacent band performance |               |
|---------|---------------------------------|---------------------|---------------|---------------------------|---------------|
|         | Analog channel output frequency | Measured across     | Specification | Measured across           | Specification |
|         | 100 MHz                         | 10 to <1250 MHz     | –80 dBc       | 1250 to <5000 MHz         | –64 dBc       |
|         | 10 to <625 MHz                  | 10 to <1250 MHz     | –78 dBc       | 1250 to <5000 MHz         | –59 dBc       |
|         | 625 to <1250 MHz                | 10 to <1250 MHz     | –71 dBc       | 1250 to <5000 MHz         | –57 dBc       |
|         | 1250 to <2000 MHz               | 1250 to <2000 MHz   | –67 dBc       | 10 to <1250 MHz           | –60 dBc       |
|         |                                 | –                   | –             | 2000 to <5000 MHz         | –55 dBc       |
|         | 2000 to <3500 MHz               | 2000 to <3500 MHz   | –52 dBc       | 10 to <2000 MHz           | –48 dBc       |
|         |                                 | –                   | –             | 3500 to <5000 MHz         | –56 dBc       |
|         | 3500 to <4000 MHz               | 3500 to <4000 MHz   | –55 dBc       | 10 to <3000 MHz           | –41 dBc       |
|         |                                 | –                   | –             | 4000 to <5000 MHz         | –58 dBc       |

## Clock characteristics

### Clock in

|                 |                          |
|-----------------|--------------------------|
| Connector       | SMA (rear panel)         |
| Input impedance | 50 $\Omega$ , AC coupled |
| Frequency range | 2.5 GHz to 5 GHz         |
| Input amplitude | 0 dBm to +10 dBm         |

### Clock output

|                  |                        |
|------------------|------------------------|
| Connector        | SMA on rear-panel      |
| Output impedance | 50 $\Omega$ AC Coupled |
| Frequency range  | 2.5 GHz to 5 GHz       |
| Output amplitude | +3 dBm to +10 dBm      |

### Sampling clock

|            |   |
|------------|---|
| Resolution | Up to 8 digits                            |
| Accuracy   | Dependent on reference frequency accuracy |

### Synchronization clock output

|           |  |
|-----------|--|
| Frequency | External clock output /32                        |
| Amplitude | 0.85 V to 1.25 V <sub>p-p</sub> into 50 $\Omega$ |
| Connector | SMA (rear panel)                                 |
| Impedance | 50 $\Omega$ , AC coupled                         |

**Trigger in**

|             |  |
|-------------|--|
| Inputs      | 2 (A and B)  |
| Polarity    | Pos or Neg   |
| Impedance   | 50 $\Omega$ , 1 k $\Omega$                                     |
| Input range | 50 $\Omega$ : <5 V <sub>rms</sub><br>1 k $\Omega$ : $\pm 10$ V |
| Connector   | SMA (rear panel)   |

|           |            |                             |
|-----------|------------|-----------------------------|
| Threshold | Range      | -5.0 V to 5.0 V             |
|           | Resolution | 0.1 V                       |
|           | Accuracy   | $\pm(5\% + 100 \text{ mV})$ |

|                                |             |                                 |
|--------------------------------|-------------|---------------------------------|
| Trigger Delay to Analog Output | Synchronous | 8275 / fclk + 30 ns $\pm 20$ ns |
|--------------------------------|-------------|---------------------------------|

|                            |                    |                             |
|----------------------------|--------------------|-----------------------------|
| Synchronous Trigger Jitter | Synchronous mode   | 50 $\Omega$ or 1 k $\Omega$ |
|                            | Frame synchronized | < 100 ps peak-to-peak       |

Trigger minimum pulse width 20 ns

Trigger hold-off (maximum)  
 $2432/F_{\text{CLK}} + 20 \text{ ns}$   
 506.4 ns at 5 GS/s  
 992.8 ns at 2.5 GS/s

**Reference in**

|                          |                          |
|--------------------------|--------------------------|
| Input amplitude          | -5 dBm to +5 dBm         |
| Fixed frequency range    | 10 MHz, $\pm 40$ Hz      |
| Variable frequency range | 35 MHz to 240 MHz        |
| Connector                | SMA (rear panel)         |
| Impedance                | 50 $\Omega$ , AC coupled |

**10 MHz reference**

|                        |  |
|------------------------|--|
| Connector              | SMA (rear panel)   |
| Impedance              | 50 $\Omega$ , AC coupled   |
| Amplitude              | +4 dBm $\pm 2$ dBm   |
| Frequency (guaranteed) | Within $\pm(1 \text{ ppm} + \text{Aging})$ , Aging: $\pm 1 \text{ ppm}$ per year |

## Auxiliary outputs (Flags)

|                  |                              |
|------------------|------------------------------|
| Number           | AWG5202: 4                   |
|                  | AWG5204: 4                   |
|                  | AWG5208: 8                   |
| Connector        | SMB on rear-panel            |
| Output amplitude | High 2.0 V into 50 $\Omega$  |
|                  | Low 0.7 V when sinking 10 mA |
| Output impedance | 50 $\Omega$                  |

## Markers

|  |                                      |
|--|--------------------------------------|
| Number                                   | AWG5202: Total of 8 (4 per channel)  |
|  | AWG5204: Total of 16 (4 per channel) |
|  | AWG5208: Total of 32 (4 per channel) |
| Marker sample rate                       | 2.5 GS/s to 5 GS/s                   |
| Minimum pulse width                      | 400 ps                               |
| Max data rate                            | 2.5 GS/s                             |
| Type                                     | Single-ended                         |
| Connector                                | SMA (rear panel)                     |
| Impedance                                | 50 $\Omega$                          |
| Output into 50 $\Omega$                  | Window: -0.5 V to 1.7 V              |
|  | Amplitude: 200 mV to 1.75 V          |
|  | Resolution: 100 $\mu$ V              |
| Rise time                                | (20% - 80%): 150 ps                  |
| Skew between markers of the same channel | <25 ps                               |
| Delay control                            | $\pm$ 2 ns                           |
| Random jitter                            | 5 ps                                 |

## Pattern jump

### Pin assignments

| Pin |                   | Pin |                   | Pin |                   |
|-----|-------------------|-----|-------------------|-----|-------------------|
| 1   | GND               | 6   | GND               | 11  | Jump bit 5, input |
| 2   | Jump bit 0, input | 7   | Strobe, input     | 12  | Jump bit 6, input |
| 3   | Jump bit 1, input | 8   | GND               | 13  | Jump bit 7, input |
| 4   | Jump bit 2, input | 9   | GND               | 14  | GND               |
| 5   | Jump bit 3, input | 10  | Jump bit 4, input | 15  | GND               |

**Input impedance** 1 kΩ pull-down to +5 VDC

**Input levels** 3.3 V LVC  
5 V TTL compliant

**Number of destinations** 256

**Strobe polarity** Negative and positive edge (selectable)

**Strobe Minimum Pulse Width** 20 ns

**Strobe Setup and Hold** Setup: 20 ns  
Hold: 20 ns

## Waveform capability

### Waveform file import capability

Import waveform format by series:

.AWGX file created by Tektronix AWG5200/70000 Series

.AWG file created by Tektronix AWG5000 or AWG7000 Series

.PAT and \*.WFM file formats created by Tektronix AWG400/500/600/700 Series

.IQT file format created by Tektronix RSA3000 Series

.TIQ file format created by Tektronix RSA6000/5000 Series or MDO4000 Series

.WFM or \*.ISF file formats created by Tektronix TDS/DPO/MSO/DSA Series

.TXT file format

.MAT Matlab file format

.SEQX file format created by Tektronix AWG5200 Series

.SEQ file format created by the Tektronix AWG400/500/600/700 Series

.TMP or .PRM file formats; Midas Blue (Data Type 1000/1001; Scalar and complex data; 8-, 16-, 32-, and 64-bit integer and 32- and 64-bit float data format types)

### Waveform file export capability

.WFMX file format, AWG5200/70000 series native format

.WFM file format, AWG400/500/600/700 waveform file

.TIQ file format, RSA6000 IQ Pair

.TXT file format

## Physical characteristics

### Dimensions

|        |                     |
|--------|---------------------|
| Height | 153.6 mm (6.05 in)  |
| Width  | 460.5 mm (18.13 in) |
| Depth  | 603 mm (23.76 in)   |

### Weight

|         |   |
|---------|---|
| AWG5202 | 44 lb (19.96 kg), 46.35 lb (21.02 kg) with packaging    |
| AWG5204 | 45.45 lb (20.62 kg), 47.75 lb (21.66 kg) with packaging |
| AWG5208 | 50.7 lb (23 kg), 53 lb (24.04 kg) with packaging        |

### Cooling clearance

|            |              |
|------------|--------------|
| Top        | 0 in         |
| Bottom     | 0 in         |
| Left side  | 50 mm (2 in) |
| Right side | 50 mm (2 in) |
| Rear       | 0 in         |

### Power supply

|               |                           |
|---------------|---------------------------|
| AC line input | 100 to 240 V AC, 50/60 Hz |
| Consumption   | 750 Watts, maximum        |

## EMC, Environment, Safety

### Temperature

|               |                                     |
|---------------|-------------------------------------|
| Operating     | 0 °C to +50 °C (+32 °F to +122 °F)  |
| Non-operating | -20 °C to +60 °C (-4 °F to +140 °F) |

### Humidity

|               |  |
|---------------|--|
| Operating     | 5% to 90% relative humidity (% RH) at up to 30 °C<br>5% to 45% relative humidity above 30 °C up to 50 °C<br>Non-condensing |
| Non-operating | 5% to 90% relative humidity (% RH) at up to 30 °C<br>5% to 45% relative humidity above 30 °C up to 60 °C<br>Non-condensing |

### Altitude

|              |   |
|--------------|---|
| Operating    | Up to 3,000 meters (9,843 feet)<br>Derate maximum operating temperature by 1 °C per 300 meters above 1500 meters. |
| Nonoperating | Up to 12,000 meters (39,370 feet)   |

### Mechanical shock

|           |   |
|-----------|---|
| Operating | Half-sine mechanical shocks, 30 g peak, 11 ms duration, 3 drops in each direction of each axis. |
|-----------|---|

### Regulatory

|           |   |
|-----------|---|
| Safety    | UL61010-1, CAN/CSA-22.2, No.61010-1-04, EN61010-1, IEC61010-1 |
| Emissions | EN55011 (Class A), IEC61000-3-2, IEC61000-3-3                 |
| Immunity  | IEC61326, IEC61000-4-2/3/4/5/6/8/11                           |

### Regional certifications

| Europe  | Australia/New Zealand |
|---------|-----------------------|
| EN61326 | AS/NZS 2064           |



## Ordering information

### AWG5200 family

|                |  |
|----------------|--|
| <b>AWG5202</b> | 16 bit, 2 GSamples/channel record length, 2-channel arbitrary waveform generator |
| AWG5200-225    | 2.5 GS/s   |
| AWG5200-250    | 5 GS/s (10 GS/s interpolated)  |
| AWG5200-2DC    | High Bandwidth Amplified outputs   |
| AWG5200-2HV    | High Voltage outputs   |
| AWG5200-2AC    | AC Amplified outputs   |
| AWG5200-2DIGUP | Digital up conversion (requires AWG5200-250)                                     |
| AWG5200-SEQ    | Sequencing   |
| AWG5202-ACCY01 | USB mouse, compact USB keyboard, touch screen stylus                             |
| <b>AWG5204</b> | 16 bit, 2 GSamples/channel record length, 4-channel arbitrary waveform generator |
| AWG5200-425    | 2.5 GS/s   |
| AWG5200-450    | 5 GS/s (10 GS/s interpolated)  |
| AWG5200-4DC    | High Bandwidth Amplified outputs   |
| AWG5200-4HV    | High Voltage outputs   |
| AWG5200-4AC    | AC Amplified outputs   |
| AWG5200-4DIGUP | Digital up conversion (requires AWG5200-450)                                     |
| AWG5200-SEQ    | Sequencing   |
| AWG5204-ACCY01 | USB mouse, compact USB keyboard, touch screen stylus                             |
| <b>AWG5208</b> | 16 bit, 2 GSamples/channel record length, 8-channel arbitrary waveform generator |
| AWG5200-825    | 2.5 GS/s   |
| AWG5200-850    | 5 GS/s (10 GS/s interpolated)  |
| AWG5200-8DC    | High Bandwidth Amplified outputs   |
| AWG5200-8HV    | High Voltage outputs   |
| AWG5200-8AC    | AC Amplified outputs   |
| AWG5200-8DIGUP | Digital up conversion (requires AWG5200-850)                                     |
| AWG5200-SEQ    | Sequencing   |
| AWG5208-ACCY01 | USB mouse, compact USB keyboard, touch screen stylus                             |

### Standard accessories <sup>1</sup>

|             |   |
|-------------|---|
| 136-7162-xx | Two 50 $\Omega$ , 18 GHz, SMA terminators per channel |
| 071-3529-xx | Installation and safety manual (English)              |
| —           | Certificate of calibration                            |
| —           | Power cord  |

<sup>1</sup> Specify power cord and language option at time of order

## Options

### Power plug options

|          |  |
|----------|--|
| Opt. A0  | North America power plug (115 V, 60 Hz)  |
| Opt. A1  | Universal Euro power plug (220 V, 50 Hz) |
| Opt. A2  | United Kingdom power plug (240 V, 50 Hz) |
| Opt. A3  | Australia power plug (240 V, 50 Hz)      |
| Opt. A4  | North America power plug (240 V, 50 Hz)  |
| Opt. A5  | Switzerland power plug (220 V, 50 Hz)    |
| Opt. A6  | Japan power plug (100 V, 50/60 Hz)       |
| Opt. A10 | China power plug (50 Hz)                 |
| Opt. A11 | India power plug (50 Hz)                 |
| Opt. A12 | Brazil power plug (60 Hz)                |
| Opt. A99 | No power cord                            |

### Language options

|          |                            |
|----------|----------------------------|
| Opt. L0  | English manual             |
| Opt. L5  | Japanese manual            |
| Opt. L7  | Simplified Chinese manual  |
| Opt. L8  | Traditional Chinese manual |
| Opt. L10 | Russian manual             |
| Opt. L99 | No manual                  |

### Service options

|          |  |
|----------|--|
| Opt. C3  | Calibration Service 3 Years  |
| Opt. C5  | Calibration Service 5 Years  |
| Opt. CA1 | Single Calibration or Functional Verification                            |
| Opt. D1  | Calibration Data Report  |
| Opt. D3  | Calibration Data Report 3 Years (with Opt. C3)                           |
| Opt. D5  | Calibration Data Report 5 Years (with Opt. C5)                           |
| Opt. G3  | Complete Care 3 Years (includes loaner, scheduled calibration, and more) |
| Opt. G5  | Complete Care 5 Years (includes loaner, scheduled calibration, and more) |
| Opt. IF  | Upgrade Installation Service   |
| Opt. R3  | Repair Service 3 Years (including warranty)                              |
| Opt. R5  | Repair Service 5 Years (including warranty)                              |

## Post sales service options

|      |   |
|------|---|
| CA1  | Single calibration or functional verification |
| R5DW | Repair service coverage 5 years               |
| R2PW | Repair service coverage 2 years post warranty |
| R1PW | Repair service coverage 1 year post warranty  |

## Recommended accessories

| Item                                  | Description   | Part number                 |
|---------------------------------------|---|-----------------------------|
| GPIO to Ethernet Instrument Interface | GPIO to USB Adapter enables GPIO control through USB B port | ICS Model 4865B             |
| Power Splitters                       | 1.5 kHz - 18 GHz  | Mini-Circuits ZX10-2-183-S+ |
|                                       | DC-18 GHz   | Varies                      |
| Amplifiers                            | 2.5 kHz - 10 GHz, 26 dB gain                                | Varies                      |
|                                       | 0.01 - 20 GHz, 30 dB gain                                   | RF-Lambda RAMP00G20GA       |
| Adapter                               | SMB female to SMA female                                    | Mouser 565-72979            |
| Pelican case                          | Hard transit case for AWG5200 series, AWG70000 series       | 016-2127-00                 |
| Programmer manual                     | Programming commands, English only                          | Visit Tektronix website     |

## Rack mount kit

|           |                |
|-----------|----------------|
| GF-RACK3U | Rack mount kit |
|-----------|----------------|

## Product upgrades

### AWG5202

|                   |   |
|-------------------|---|
| AWG52UP Opt SSD   | Provides an additional (or replacement) preprogrammed solid state drive       |
| AWG52UP SSD-SPARE | Spare (or replacement) SSD with a Win10 OS image for AWG5200 products         |
| AWG52UP SSD-WIN10 | SSD with Win10 OS image and license; functions as an upgrade for AWG5200 Win7 |
| AWG5200-2-2550    | Increases sampling rate from 2.5 GS/s to 5 GS/s (10 GS/s interpolated)        |
| AWG5200-2DC       | Adds DC High Bandwidth Amplified outputs                                      |
| AWG5200-2HV       | Adds DC High Voltage outputs (SN B020000 and above only)                      |
| AWG5200-2AC       | Adds AC Amplified outputs   |
| AWG5200-2DIGUP    | Adds digital up conversion (requires AWG5200-250 or AWG5200-2-2550)           |
| AWG5200-SEQ       | Adds Sequencing   |

### AWG5204

|                   |   |
|-------------------|---|
| AWG52UP Opt SSD   | Provides an additional (or replacement) preprogrammed solid state drive       |
| AWG52UP SSD-SPARE | Spare (or replacement) SSD with a Win10 OS image for AWG5200 products         |
| AWG52UP SSD-WIN10 | SSD with Win10 OS image and license; functions as an upgrade for AWG5200 Win7 |
| AWG5200-4-2550    | Increases sampling rate from 2.5 GS/s to 5 GS/s (10 GS/s interpolated)        |
| AWG5200-4DC       | Adds DC High Bandwidth Amplified outputs                                      |
| AWG5200-4HV       | Adds DC High Voltage outputs (SN B020000 and above only)                      |
| AWG5200-4AC       | Adds AC Amplified outputs   |

**AWG5200-4DIGUP** Adds digital up conversion (requires AWG5200-450 or AWG5200-4-2550)

**AWG5200-SEQ** Adds Sequencing

#### AWG5208

**AWG52UP Opt SSD** Provides an additional (or replacement) preprogrammed solid state drive

**AWG52UP SSD-SPARE** Spare (or replacement) SSD with a Win10 OS image for AWG5200 products

**AWG52UP SSD-WIN10** SSD with Win10 OS image and license; functions as an upgrade for AWG5200 Win7

**AWG5200-8-2550** Increases sampling rate from 2.5 GS/s to 5 GS/s (10 GS/s interpolated)

**AWG5200-8DC** Adds DC High Bandwidth Amplified outputs

**AWG5200-8HV** Adds DC High Voltage outputs (SN B020000 and above only)

**AWG5200-8AC** Adds AC Amplified outputs

**AWG5200-8DIGUP** Adds digital up conversion (requires AWG5200-850 or AWG5200-8-2550)

**AWG5200-SEQ** Adds Sequencing

## Plug-ins

Plug-ins increase the capabilities of the arbitrary waveform generators. Various plug-ins are available providing unique types of waveforms or additional compensation. Each plug-in has its own installation file which installs seamlessly into the generators. After installation, it simply becomes a new menu selection. No other configuration is necessary.

| Plug-in                   | Description   | Nomenclature   | Licensed enhancements  |
|---------------------------|---|--|--|
| Multitone & Chirp plug-in | Create chirps, notches, and tones   | MTONENL-SS01<br>MTONEFL-SS01                                 |  |
| PreCompensation plug-in   | Create correction coefficients that can be applied on waveforms to get flat frequency and linear phase response | PRECOMNL-SS01<br>PRECOMFL-SS01                               |  |
| High Speed Serial plug-in | Create pre-distorted waveforms to test a device's conformance to standards                                      | HSSNL-SS01<br>HSSFL-SS01<br>HSSPACKNL-SS01<br>HSSPACKFL-SS01 | S-Parameters and Intersymbol Interference unlocked with S-Parameters plug-in license<br>Spread Spectrum Clocking unlocked with Spread Spectrum Clocking plug-in license<br>(Licensed enhancements are included with HSSPACK) |
| RF Generic plug-in        | Create digitally modulated signals with multiple carrier groups   | RFGENNL-SS01<br>RFGENFL-SS01                                 | S-Parameters unlocked with S-Parameters plug-in license  |
| Optical plug-in           | Create waveforms with complex modulation schemes for optical testing  | OPTICALNL-SS01<br>OPTICALFL-SS01                             | S-Parameters unlocked with S-Parameters plug-in license<br>Spread Spectrum Clocking unlocked with Spread Spectrum Clocking plug-in license   |
| OFDM plug-in              | Create Single or Multiple OFDM based Frames with one or more bursts   | OFDMNL-SS01<br>OFDMFL-SS01                                   | S-Parameters unlocked with S-Parameters plug-in license  |
| RADAR plug-in             | Create RADAR pulsed waveforms with various modulations and impairments  | RADARNL-SS01<br>RADARFL-SS01                                 | S-Parameters unlocked with S-Parameters plug-in license  |
|                           | RADAR and Environment waveform creation plug-ins packaged together  | RDRPACK1NL-SS01<br>RDRPACK1FL-SS01                           |  |
|                           | RADAR, Environment, and OFDM waveform creation plug-ins packaged together                                       | RDRPACK2NL-SS01<br>RDRPACK2FL-SS01                           |  |
| RADAR plug-in             | Create RADAR pulsed waveforms with various modulations and impairments  | RADARNL-SS01<br>RADARFL-SS01                                 | S-Parameters unlocked with S-Parameters plug-in license  |

| Plug-in  | Description   | Nomenclature                 | Licensed enhancements |
|--|---|------------------------------|-----------------------|
| Environment plug-in  | Create real world scenarios for commercial, electronic warfare, and simulations for monitoring and receiver testing | ENVNL-SS01<br>ENVFL-SS01     |                       |
| Spread Spectrum Clocking plug-in                                 | Adds SSC capability to the High Speed Serial and Optical plug-ins   | SSCFLNL-SS01<br>SSCFLFL-SS01 |                       |
| S-Parameters plug-in   | Adds S-Parameter capability to the RF Generic, High Speed Serial, Optical, OFDM, and RADAR plug-ins                 | SPARANL-SS01<br>SPARAFL-SS01 |                       |
| Pattern Generator, Pulse, & LVDS Video Signal Generator plug-ins |   | Free web download            |                       |

Plug-ins require the purchase of a license before they are fully functional.

There are two types of licenses available for each plug-in: node-locked (NL) and floating (FL).

- Node Locked Licenses (NL) provide your own copy of the application on your instrument and are permanently assigned to a product model/serial number.
- Floating Licenses (FL) can be moved between product models.

## Warranty

One-year parts and labor.



Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.



Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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